A Synopsis On

"PHARMACOLOGICAL ACTIVITIES OF SELECTED PLANTS OF FABACEAE"

Submitted For

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Abstract of Proposed Workplan/Problem:

Medicinal plants are becoming more and more popular all over the world because of their unique advantages and therapeutic significance. Peoples are increasingly turning to herbal therapy as a substitute for conventional medicine. Due to their growing societal acceptance and common use, these therapeutic potential plants are highly regarded, which have very few adverse effects, and are consequently rising interest throughout the world.Most developing nations are encouraging the use of herbal medications, which are frequently more affordable than synthetic medicines. The pharmaceutical industry can create different types of medications from medicinal plants.The use of plants and their many preparations will be crucial in medical research, particularly in the treatment of serious diseases like cancer, diabetes, Alzheimer's, and arthritis.

The main goal of the present investigation is to find pharmacognostic evaluations for different medicinal plants from the Fabaceae family for the treatment, prevention and management of various chronic diseases.The significance of this study is aimed to provide a detailed and collective scientific evaluation of the plants and its pharmacological action for the possible development of new phytomedicine formulations.

1. Introduction:

The use of therapeutic plant-derived medications has drawn more attention in both conventional and contemporary medical systems. As a consequence, the demand for medicinal plants has increased globally, which has led to the collecting of these plants from their natural habitat. Due to the fact that the medicines made from these plants are crucial for maintaining population health, which in turn is vital for preserving the economies of the nations, these plants play a significant role in the production of phytomedicines in low income countries. The inhabitants in these nations may earn a living by growing medicinal plants, which providebetter health to the individuals. According to reports, valuable medicinal plants reportedly thrive across Asia, mostly in weakened ecosystems that are inhabited primarily by rural and indigenous populations.These plants have long been known to humans, and ancient literature points to their usage in ceremonies of faith and for disease treatment in places like India. To make nations more reliant on their own pharmaceutical resources and to help manage the conditions caused by endemic diseases, the use of medicinal plants should be encouraged. Both developed and developing nations prescribe these plants and the medications that are derived from them. By enhancing the healthcare delivery system, which will enable the populace to purchase the

medication at reasonable rates, this technique would ultimately result in the expanding the herbal pharmaceutical companies of developing nations.For over a thousand years, many plant species have been identified as a potential source to produce therapeutic medicines, and even today, the majority of pharmaceuticals used in clinical practice are still natural compounds made from plants. Over millennia, beginning in the first millennium BC, the Indian Ayurveda system was documented. (Atanasovetal.,2015).

The plant contains different phytochemicals such as coumarins, saponins, alkaloids, flavonoids, isoflavones etc. It is quite amazing the variety of medicinal plants that are found all over the globe.Approximately 70,000 plant species, including lower-level plants to higher-level trees, have reportedly been shown to have the capacity to cure a variety of diseases (Kuruppu*etal.*,2019).

21,000 medicinal plants are used for a variety of medical applications, according to the WHO. Even today, traditional herbal experts are known to use the herbal medicine system in rural regions, employing over 2500 plants to treat common illnesses, which has been recognized as one of the greatest approaches in Indian traditional medicine. (Panmeietal.,2019).

India is the home of more than 100 genera of plants that are utilized in traditional medicines around the globe. India ranks second in terms of exports and offers the highest quality and quantity of medicinal plants. With 16 agro-climatic zones and a variety of around 45,000 plants, it is one of the world's 12 mega biodiversity hotspots. Of these, 7000 plant species are known to be medicinal plants (Chakraborty, 2018).

There are many plants in Fabaceae family which are medicinal ones. Therefore, present research topic was selected to study herbal medicines containing ingredients of the selected plant species of Fabaceae as antioxidant, anticataract, antiangiogenic, antimicrobial and anti-inflammatory agents.

2. Review of Literature:

As per the universal statistics, 80% of world’s populations primarily rely on ethnobotanical remedies and herbal medicine, e.g. analgesic: morphine; codeine; antineoplastic: camptothecin, taxol, antidiabetic: allicin, antimalarial, artemisinin, quinine; cardiac depressant: quinidine; antigout: colchicines; antidiabetic: allicin, and forbrain functions: nicotine and caffeine (Kamboj, 2000).

Based on the location of plant growth both the quality and quantity of an active component most often a secondary metabolite will differ (Vishwanathan and Basavaraju, 2010).

Plant metabolite can be of two types; primary and secondary. Primary metabolites such as amino acids, proteins, sugar, nucleic acids and polysaccharides are a like in every living cells and are involved in growth and development. From the primary metabolic pathways, secondary metabolites are derived and are not involved in growth. Since secondary metabolites have shown to have various biological effects, it is widely used as traditional medicine (HusseinandEl-Anssary, 2018).

Plant metabolites are classified into three types namely terpenoids, alkaloids, andphenolics. Terpenoids are the largest class of plant metabolites containing more than 40,000 compounds while phenolics comprise nearly 8000 compounds (Ahmed*etal.*, 2017).

The stem extract of *Abelmoschus manihot* has been reported to have an anti-inflammatory effect, while the leaves extract showed distinct analgesic and antioxidant effects (Pan*etal.*, 2018).

Abelmoschus manihot has been known to have medicinal benefits for treating diabetic mellitus, improving renal function, and preventing ischemic brain damage. *Abelmoschus manihot* has emerged as an essential element of Huang Kui Capsule, which is utilised as the most significant medication in China for the management of chronic glomerulonephritis and nephropathy caused by diabetes. (Guo*etal.*,2013).

The extracts from the plant *Abutilon indicum* are used to treat diabetes, piles, haemorrhoids, injuries, ulcers, and genital and urinary tract ailments. The extracts work well for treating piles, haemorrhoids, diabetes, vaginal infections, and urinary tract disorders in addition to wounds and ulcerations. The leaf extracts have hepatoprotective and anti-hyperglycemic properties. (Krisanapun et al.,2009).

It is used locally to treat worm infections, high fevers, mumps, TB, bronchitis, carbuncles, diarrhoea, and colds. (Abduletal.,2010).

The leaves are demulcent, making them useful for treating gonorrhoea, toothaches, and sore gums.In India, *Datura metel* is well-known and often used to cure a variety of illnesses, including convulsions, anxiety, vomiting, skin, and heart problems. (Alabrietal.,2014).

A tree known as *Thespesia populnea* (L.) (Malvaceae) is most often found in tropical and coastal areas of India. "Indian tulip tree" is a commonly used name. *Thespesia populnea's* therapeutic characteristics are discussed in ancient Ayurvedic writings. The different plant components have been used to treat liver illnesses, dysentery, cholera, and skin problems such as scabies, psoriasis, and worms. (Ilavarasan et al., 2003).

For the treatment of gonorrhoea and urinary tract infections, the oil from the bark of the tree is mixed with plant-based oil. The oil is also used as a traditional medication for boils, ulcers, and crack injuries. (Vasudevan and Parle, 2006).

According to (Shah and Alagawadi, 2011).These compounds exhibit hepatoprotective, antihyperglycemic, antinociceptive, anti-inflammatory, and antidiarrheal effects.*Thespesia populnea's* main ingredient, gossypol, has antiviral and anticancer properties. In both rats and people, it has anti-inflammatory in nature and antifertility effects. *Solanum surattense* is a perpetual herbal weed of Solanaceae family. It is widely found in tropical regions of India (Mickymaray et al.,2016).

The plant *Solanum surattense*, also known as Indian nightshade or yellow berried nightshade, has been used to cure a variety of conditions, including diabetes, asthma, fever, and cough, particularly in south Indian cultures. (Thirumalaietal.,2012).

The antioxidant properties of the alcoholic extract of the leaves of *Solanum surattense* were shown by Muruhan et al.'s phytochemical research, which were presumably made possible by the presence of alkaloids, flavonoids, tannins, glycosides, triterpenoids, and sterols. By using DPPH and ABTS tests, the antioxidant property of the plant extracts was investigated. The plant extract's total amount of phenolic compounds was estimated to be 46.7 mg gallic acid equivalents. The considerable antioxidant activity may be attributed to the high concentration of phenolic chemicals. (Muruhanetal.,2013).

Alcoholic extracts of *Solanum surattense* have been shown to have antibacterial properties against *Staphylococcus aureus*, Streptococcus sp., *Bacillus subtilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Salmonella typhi*, *Shigella dysenteriae*, and *Vibrio cholera*. Leaf extracts at five different concentrations (25, 50, 100, 250, and 500 g) were tested for their ability to inhibit microorganisms. Among the pathogens, *Staphylococcus aureus*, Streptococcus sp., *Bacillus subtilis*, *Escherichia coli*, *Salmonella typhi*, and *Vibrio cholera* have all displayed strong antibacterial activity in response to plant extract at all doses. With the exception of 25 g, the extract displayed antibacterial action against *Pseudomonas auroginosa*, while it had no effect on *Shigella dysenteriae* at any concentration. Sheeba (2010).Diabetes-induced rats were given *Solanum surattense* 100 mg/kg b.w. for 45 days, after which the parameters dramatically returned to normal. The findings suggest that a variety of phytoconstituents, including alkaloids, flavonoids, glycosides, sterols, tannins, and triterpenoids, may contribute to the antihyperlipidemic activity of Solanum surattense extracts. (Sridevi et al., 2011).Aphrodisiac, antidiabetic, anti-inflammatory, analgesic, neuroprotective, and antioxidant activities are all present in *Mucuna pruriens* (L.). Tan et al. investigated the protective properties of *M.*

*pruriens*seed extract against the snake venom of *Naja sputatrix* and *Calloselasma rhodostoma* with survival rates of 84% and 33% after three injections at the dosage of 21 mg/kg in rats. (Tan et al., 2009).

Senna auriculata (L.) Roxb., sometimes known as *Cassia auriculata*, is a herbaceous plant that may reach heights of 1.2 to 3.0 metres. There are many recognized uses for this plant's different components. A healthy tea that persons with diabetes, urinary tract infections, and constipation have all drank. Additionally, it is said to have hepatoprotective, antihyperlipidemic, antipyretic, antibacterial, and anthelmintic properties. (Khader et al.,2017).

The weed *Eclipta alba* (L.) belongs to the Asteraceae family. It is often seen in both tropical and subtropical areas and demonstrates a variety of ecological functions. It is often used to treat viral infections, infective hepatitis turning bald, and snake venom injury in India. *Eclipta alba* is utilised to restore the function of the liver in Ayurveda since it has been shown to have protective properties for the liver cells. Water and ethanol extracts of *Saussurealappa* root have been shown to have antibacterial activity against a number of specific human pathogens, including *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, *Escherichia coli*, *Klebsiella pneumonia*, and methicillin-resistant *Staphylococcus aureus*. No antibacterial action was detected in the aqueous extract against bacterial infections. Excellent antibacterial activity was shown in ethanol extract against all human diseases. *P. aeruginosa* and Extended Spectrum Beta-Lactamase among the pathogens investigated showed a maximum 29 mm zone of inhibition at 12 g dose. *K. pneumonia* and *A. baumannii* then displayed a 23 mm zone of inhibition, whereas methicillin-resistant *S. aureus* and *E. coli* had a 21 mm zone of inhibition at the same dose. (Hassonetal.,2013).

Gymnema sylvestre is a common herbal plant in India that belongs to the Apocynaceae family. The plant is known locally as gurmar, which means "sweet destroyer," or madhunashini. Ayurvedic medicine uses the medicinal herb *G. sylvestre* to treat type 2 diabetes mellitus (Pham*etal.*,2018).

3. Objectives of Research:

1. To study the free radical scavenging activity of selected plants
2. To study the antimicrobial activity of selected plants
3. To study the anticataract activity of selected plants
4. To study the anti-inflammatory activity of selected plants

5. To study the antiangiogenic activity of selected plants
6. To study the toxicity of the selected plant extracts using cell lines.

4. Methodology to be adopted:

- Collection of selected plant material will be done from its natural habitat. Different extracts of selected plants will be made in different solvents like water, ethanol, chloroform and toluene etc. using Soxhlet apparatus.
- To studyfree radical scavenging activity of different plant extracts,a method suggested by Brand-Williams *et al.,* 1995 shall be used.
- To study the antimicrobial activity of different plant extracts, a method suggested by Ahmad *et al.,* 1998 shall be used.
- To study the anticataract activity of differentplant extracts,a method suggested by Hajarnavis & Bulakh, 2020 shall be used.
- To study the anti-inflammatory activity of differentplant extracts, amethod suggested by Jager *et al.,* 1996shall be used.
- To study the anti-angiogenic activity of the differentplant extracts,a method suggested by Lee *et al.,* 2008shall be used.
- To study the toxicity of selected plant extracts using cell lines, a method suggested by Mosmann, 1983 shall be used.

5. Importance of study:

International status:

Medicinal plants should be a part of illness prevention measures in Africa due to the region's rich variety of plants and the relative affordability of employing plant-derived medications as opposed to processed synthetic treatments. These socioeconomic aspects must be taken into consideration in any approach for illness prevention in the developing world, particularly in Africa. Plans have been made for development strategies in the first and second decades of traditional medicine in Africa.Based on whether or not a transmissible biologic disease-causing agent is present, diseases are classified as communicable or non-communicable. Prior to recently, non-communicable diseases predominated in developed (high resource) countries, where improvements in living conditions and widespread

adoption of technology had brought communicable diseases (CDs) under control. In contrast, communicable diseases (CDs) were the main causes of ill health and deaths in developing (low and middle resource) countries. With the advent of new infectious illnesses and the resurgence of established disease agents, the hope that communicable diseases would be less of a health burden in industrialized nations seems to have been mistaken. Similar to this, non-communicable illnesses are already a significant contributor to morbidity and death in emerging nations due to globalization and changing lifestyles(Mazid et al., 2011). Therefore, NCDs and CDs account for almost similar amounts of morbidity and death globally, placing a twofold disease burden on all nations at the moment. In terms of the total health and socioeconomic effects, poor and medium income nations face a graver situation. Three main tactics are used. The primary methods for preventing communicable illnesses are surveillance, outbreak investigations, and immunization. Several medicinal plants and traditional medicines made from them have been utilized to improve immune response to a variety of disease agents, even if they may seem to have a little part in these methods (Panmei et al., 2019)

Plants are still employed as a traditional form of healing against several ailments in the current age of medicine. By creating specific compounds or secondary metabolites that are non-nutritive nevertheless effective in defensive mechanisms, plants may defend themselves against pathogenic bacteria, dangerous insects, and unfavorable environmental changes. These are called phytochemicals and resemble essential oils in several ways.It can defend not just plants but also people and animals against some illnesses that are brought on by bacteria or the poisons such microorganisms develop. This is because it has antibacterial qualities. Phytochemicals may one day be used as chemopreventive agents.Based on differences in chemical structure, several phytochemicals have been identified to far and categorised into key classes. Phytosterols, flavonoids, terpenoids, saponins, alkaloids, carotenoids, aromatic acids, organic acids, essential oils, and protease inhibitors are the main categories of phytochemicals.The metabolites may act as a direct or indirect defence mechanism against infections or hazardous conditions since they possess qualities including antibacterial, anti-inflammatory, anthelmintic, anticarcinogenic, antigenotoxic, antiproliferative, antimutagenic, and antioxidative.Plant based medicine is the main strategy to overcome the prevention and treatment of different diseases. (Di Pierro*et al.,* 2020).

National status:

Plant medicine has been used for a very long time, particularly by Indian groups with a lengthy history.Plants generate phytochemicals as a defensive strategy against infections. As a component of traditional medicine, they are used to treat a variety of metabolic, immune, and neurological diseases in people across the globe. With an expanding population, more native plants are being used in commercial medicine. Demand raised as a result of preventive disease management as plant extracts' has different medicinal characteristics. On the other hand, plant tissue culture has shown to be a dependable substitute for the synthesis of bioactive chemicals from plants. Nearly 80% of the world's population is thought to frequently rely on traditional medicines and goods, particularly in third-world nations, for their healthcare requirements. In developing nations, many ill patients mix conventional medication with traditional medicine. Traditional medicines are often less expensive than contemporary medications, and they are likely the only natural therapies accessible in distant rural areas of underdeveloped nations. Due to their accessibility to traditional healers and the fact that they are familiar with their cultures and environments as well as their patients, rural residents prefer traditional remedies. Due to the concentration of traditional healthcare in urban areas, access to western healthcare in rural regions is a challenge, particularly in Sub-Saharan nations. Because there are more plant species, more medicinal plants have been discovered in the area. In India, more than 70% of the population initially turns to locally available, home-made treatments, and more than 90% employ plant-related cures at some point. Another essential component of India's indigenous populations, who have accumulated important traditional knowledge through decades, is phytotherapy(Patel and Rajput, 2013). However, because of industrialization and the adoption of western lifestyles, this practice is often less widely spread. Since the medicinal plants have not been properly recorded and the knowledge is transferred orally from one generation to the next, there is a risk of its loss; traditional knowledge in many Indian ethnic communities remains unexplored. The availability of plant medicine in the majority of third world countries is severely threatened by indiscriminate trade in plant resources, unregulated collecting practices, habitat change, overexploitation, and climate change. As a result, there is an urgent need for better methods of conservation and practical use of priority plant resources for prevention and management of chronic diseases(Singh *et al.*,1993).

6. Significance of study:

The significance of this study is that this study may contribute for the standardization of the herbal medicines containing ingredients of the selected plant species as antioxidant, anticataract, antiangiogenic, antimicrobial and anti-inflammatory agents.

7. Proposed work plan:

Year wise plan of work and target to be achieved

Time Duration	Work plan
First Year	❖ Collection of plant materials and drying in shade. ❖ Extraction of plants in different solvents like water, ethanol, chloroform, etc. using Soxhlet apparatus. ❖ To study the free radical scavenging activity of plant extracts ❖ To study the antimicrobial activity of plant extracts
Second Year	❖ To study the anticataract activity of plant extracts ❖ To study the anti-inflammatory properties of plant extracts
Third Year	❖ To study the antiangiogenic activity of plant extracts ❖ To study the toxicity of plant extracts using cell lines

8. References:

1. Abdul, M.M., Sarker, A.A., Saiful, I.M., Muniruddin, A., 2010. Cytotoxic and antimicrobial activity of the crude extract of Abutilon indicum. IJPPR. 2, 1–4.
2. Ahmad, I., Mehmood, Z., Mohammad, F. 1998. Screening of some Indian medicinal plants for their antimicrobial properties. J. Ethnopharmacol., 62 , pp. 183-193.

3. Ahmed, E., Arshad, M., Zakriyya Khan, M., Shoaib Amjad, H., Mehreen Sadaf, H., Riaz, I., Sabir, S., Ahmad, N., Sabaoon, M. A., 2017. Secondary metabolites and their multidimensional prospective in plant life. J. Pharmacogn. Phytochem. 205, 205–214.
4. Alabri, T.H., AlMusalami, A.H., Hossain, M.A., Weli, A.M., Al-Riyami, Q., 2014. Comparative study of phytochemical screening, antioxidant and antimicrobial capacities of fresh and dry leaves crude plant extracts of Datura metel L.J. King Saud Univ. Sci. 26,237–243.
5. Atanasov, A. G.,Waltenberger, B., Pferschy-Wenzig, E. M., Linder, T., Wawrosch, C., Uhrin, P., Temml, V., Wang, L., Schwaiger, S., Heiss, E. H., Rollinger, J. M., 2015. Discoveryand resupply of harmacologically active plant-derived natural products:a review. Biotechnol. Adv.33, 1582–1614.
6. Brand-Williams W, Cuvelier ME, Berset C: Use of free radical method to evaluate antioxidant activity. Lebensmittel-Wissenschaft und-Technol. 1995, 28: 25-30.
7. Chakraborty, P., 2018. Herbal genomics as tools for dissecting new metabolic pathway so fun explored medicinal plants and drug discovery. Biochim. Open. 6, 9–16.
8. Guo, J.M., Lin, P., Lu, Y.W., Duan, J.A., Shang, E.X., Qian, D.W., Tang,Y.P., 2013. Investigation of in vivo metabolic profile of Abelmoschus Manihot based on pattern recognition analysis. J. Ethnopharmacol. 148, 297–304.
9. Hajarnavis A.M., Bulakh P.M.2020. Anticataract effects of S. cumini and A. marmelos on goat lenses in an experimental diabetic cataract model. Journal of Ayurveda and Integrative Medicine 11, 421-425.
10. Hasson, S.S., Al-Balushi, M.S., Al-Busaidi, J., Othman, M.S., Said, E.A., Habal, O., Sal- lam, T.A., Aljabri, A.A., AhmedIdris, M., 2013. Evaluation of anti–resistant activity of Auklandia (Saussurealappa) root against some human pathogens. Asian Pac. J. Trop. Biomed. 3, 557–562.
11. Hussein, R.A., El-Anssary, A.A., 2018. Plants secondary metabolites: the key drivers of the pharmacological actions of medicinal plants. Herbal Med.
12. Ilavarasan, R., Vasudevan, M., Anbazhagan, S., Venkataraman, S., 2003. Antioxidant activity of Thespesia populnea bark extracts against carbon tetrachloride-induced liver in- jury in rats. J. Ethnopharmacol. 87, 227–230.

13. Jager, A.K., Hutchings, A., Van Staden, J., 1996. Screening of Zulu medicinal plants for prostaglandin-synthesis inhibitors. Journal of Ethnopharmacology 52, 95–100.

14. Khader, S.Z., Ahmed, S.S, Balasubramanian, S.K., Kumar Arunachalam, T., Kannappan, G., Mahboob, M.R., Ponnusamy, P., Ramesh, K., 2017. Modulatory effect of dianthrone rich alcoholic flower extract of Cassia auriculata L. on experimental diabetes. Integr. Med. Res. 6, 131–140.

15. Krisanapun, C., Peungvicha, P., Temsiririrkkul, R., Wongkrajang, Y., 2009. Aqueous extract of Abutilon indicum Sweet inhibits glucose absorption and stimulates insulin secretion in rodents. Nutr Res 29,579–587.

16. Kuruppu, A. I., Paranagama, P., Goonasekara, C., 2019. Medicinal plants commonly used against cancerin traditional medicine formulae in SriLanka. Saudi Pharm. J. 27, 563–565.

17. Lee JS, Park BC, Ko YJ, Choi MK, Choi HG, Yong CS, et al. 2008. Grifolafrondosa (Maitake Mushroom) water extract inhibits vascular endothelial growth factor-induced angiogenesis through inhibition of reactive oxygen species and extracellular signal-regulated kinase phosphorylation. J Med Food, 11: 643–651.

18. Mazid, M., Khan, T.A., Mohammad, F., 2011. Role of secondary metabolites in defense mechanisms of plants. Biol. Med. 3, 232–249.

19. Mickymaray, S., Al Aboody, M.S., Rath, P.K., Annamalai, P., Nooruddin, T., 2016. Screening and antibacterial efficacy of selected Indian medicinal plants.. Asian Pac. J. Trop. Biomed. 6, 185–191.

20. Mosmann T. Rapid colorimetric assay for cellular growth and survival: application to proliferation and cytotoxicity assays. J Immunol Methods. 1983;65(1–2):55–63.

21. Muruhan, S., Selvaraj, S., Viswanathan, P.K., 2013. In vitro antioxidant activities of Solanum surattense leaf extract.. Asian Pac. J. Trop. Biomed. 3, 28–34.

22. Pan,X.X.,Tao,J.H.,Jiang,S.,Zhu,Y.,Qian,D.W.,Duan,J.A.,2018.Characterization and immunomodulatory activity of polysaccharides from the stems and leaves of *Abelmoschus manihot* and a sulfated derivative. Int. J.Biol.Macromol.107,9–16.

23. Panmei, R., Gajurel, P. R., Singh, B., 2019. Ethnobotany of medicinal plants used by the Zeliangrong ethnic group of Manipur, north east India. J. Ethnopharmacol235, 164– 182.

24. Patel, M.K., Rajput, A.P., 2013.Therapeutic significance of Abutilon indicum: an over view. Am.J.Pharm.Tech.Res.3,20–35.
25. Pham, H.T., Hoang, M.C., Ha, T.K., Dang, L.H., Tran, V.O., Nguyen, T.B., Lee, C.H., Oh, W.K., 2018. Discrimination of different geographic varieties of Gymnemasylvestre, an anti-sweet plant used for the treatment of type 2 diabetes. Phytochem- istry 150, 12–22.
26. Shah, A.S., Alagawadi, K.R., 2011. Anti-inflammatory, analgesic and antipyretic properties of Thespesia populneaSoland ex. Correa seed extracts and its fractions in animal models. J. Ethnopharmacol. 137, 1504–1509.
27. Sheeba, E. , 2010. Antibacterial activity of Solanum surattenseBurm. F. Kathmandu Uni. J. Sci. Eng. Technol. 6, 1–4 .
28. Singh, B., Saxena, A.K., Chandan, B.K., Agarwal, S.G., Bhatia, M.S., Anand, K.K., 1993. Hepatoprotective effect of ethanolic extract of Eclipta alba on experimental liver dam- age in rats and mice. Phytother Res. 7, 154–158.
29. Sridevi, M., Kalaiarasi, P., Pugalendi, K.V., 2011. Antihyperlipidemic activity of alcoholic leaf extract of Solanum surattense in streptozotocin-diabetic rats. Asian Pac J. Trop. Biomed. 1, S276–S280.
30. Tan, N.H., Fung, S.Y., Sim, S.M., Marinello, E., Guerranti, R., Aguiyi, J.C., 2009. The pro-tective effect of Mucuna pruriens seeds against snake venom poisoning. J. Ethnophar- macol. 123, 356–358.
31. Thirumalai, T., David, E., Viviyan, T.S., Elumalai, E.K., 2012. Effect of Solanum surattense seed on the oxidative potential of cauda epididymal spermatozoa. Asian Pac. J. Trop. Biomed. 2, 21–23.
32. Vasudevan, M., Parle, M., 2006. Pharmacological actions of Thespesia pop- ulnea relevant to Alzheimer's disease. Phytomedicine 13, 677–687.

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